

PIXE ANALYSIS OF MAMMOTH MOUNTAIN PINE TREES - GROWTH RINGS AND NEEDLES *, Dale W. Heikkinen and Laura J. Hainsworth, Center For Accelerator Mass Spectrometry (CAMS), Lawrence Livermore National Laboratory, Livermore, CA 94551-9900

The region around Mammoth Mountain, located in California on the eastern slope of the Sierra Nevada mountain range, has been seismically very active in recent years. Mammoth Mountain, situated on the edge of the Long Valley caldera, has had volcanic eruptions as recently as ≈ 500 years ago. The recent seismic activity has produced a large increase in the CO_2 emissions in the area which are thought to be of magmatic origin(1). This increase in ground CO_2 emissions has resulted in a pine tree kill area of some 30-hectare, most probably through inhibition of root function(2). We have undertaken a study of elemental concentrations in both needles and growth rings from pine trees taken from the tree kill area and a nearby non-kill area. The measurements were taken using a 3-MeV proton beam from the tandem Van de Graaff and the PIXE micro-beam facility at CAMS. X-rays were detected using a standard Si(Li) detector with a resolution of 185 eV. The growth ring measurements extended back for a period of some 13 years. Measurements were taken at the center of each growth ring. In addition, a comparison of the elemental distributions were obtained for pine needles obtained from the same areas. The pine needles were typically scanned in 20 micron steps over an area of 0.2×1.4 mm (transversely and longitudinally, respectively). Elements distributions have been obtained for elements from P to Sr. A comparison of elemental ratios, after normalization to the measured Ca content, shows the needles from the "dead" trees have elevated S, K, and Sr levels and reduced Zn levels. The enhancement or reduction is typically a factor of two from the values for the "live" trees. Concentrations for elements such as Mn, Cu, and Fe are nominally the same for both types.

- (1) C.D. Farrar, M.L. Sorey, W.C. Evans, J.F. Howle, B.D. Kerr, B.M. Kennedy, C.-Y. King & J.R. Southon, *Nature* 376, 675 (1995)
 (2) J. Qi, J.D. Marshall, & K.G. Mattson, *New Phytol.* 128, 435 (1994)

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contact: Dale W. Heikkinen
 Center for Accelerator Mass Spectrometry
 Lawrence Livermore National Laboratory
 P.O. Box 808 L-397
 Livermore, CA 94551-9900
 tel: (510)-422-1889
 fax: (510)-423-7884
 e-mail: heikkinen@llnl.gov